Restoring Great Basin Riparian Areas – Collaborative, Interdisciplinary FS and EPA Research

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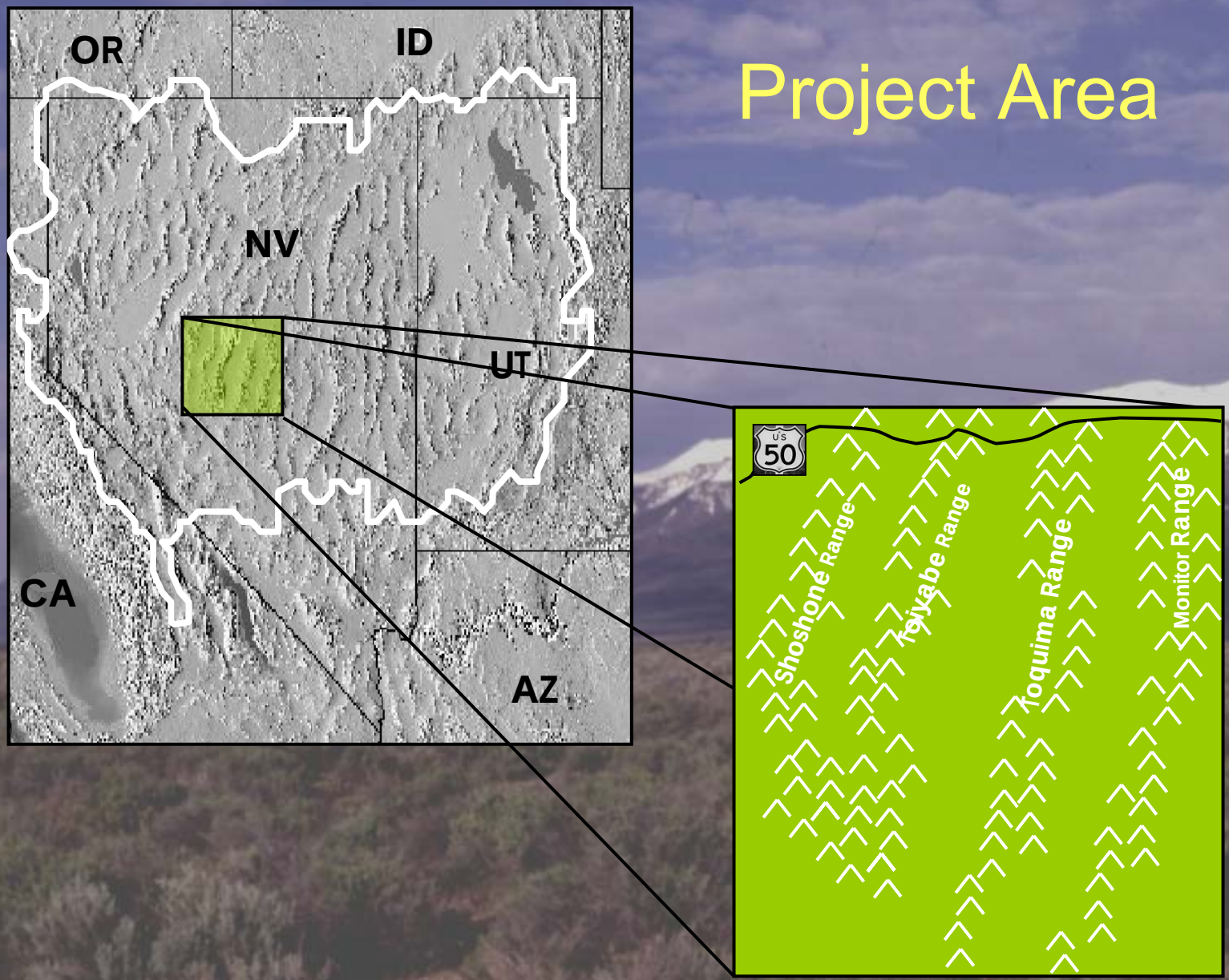
Project Area




Washington Creek
Big Creek

Barley Creek

Birch Creek


1994
1998
2003

Great Basin Ecosystem Management Project: Restoring and Maintaining Watersheds and Riparian Ecosystems

- Initiated in 1993 by RMRS to address problems associated with stream incision and riparian area degradation

- Goals aligned with mission of EPA Office of Research and Development
  - Understand basic ecosystem processes controlling stream systems and riparian areas
  - Determine the environmental and anthropogenic factors driving the changes
  - Develop and communicate methods for restoring & maintaining sustainable ecosystems

Geomorphic, Hydrologic and Vegetation Interactions of Meadows – Restoration Implications

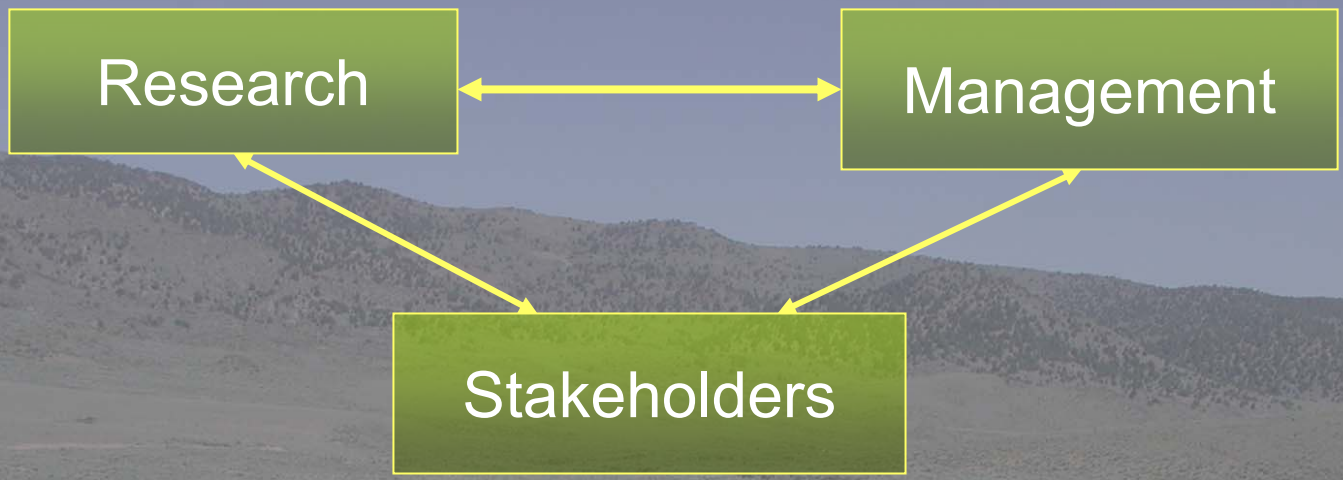
- Initiated in 2002 by EPA ORD to address problems associated with meadow degradation
  - Build on existing data to define interactions between the geomorphic, hydrologic, and biotic processes operating along the riparian corridor
  - Use this information to develop a system for prioritizing meadow restoration efforts
  - Develop appropriate restoration approaches
  - Evaluate restoration outcomes

Stakeholders & Collaborators

- EPA
- RMRS
- Humboldt-Toiyabe National Forest
- Bureau of Land Management
- Fish and Wildlife Service
- Agricultural Res. Service
- US Geological Survey
- Farmers & Ranchers

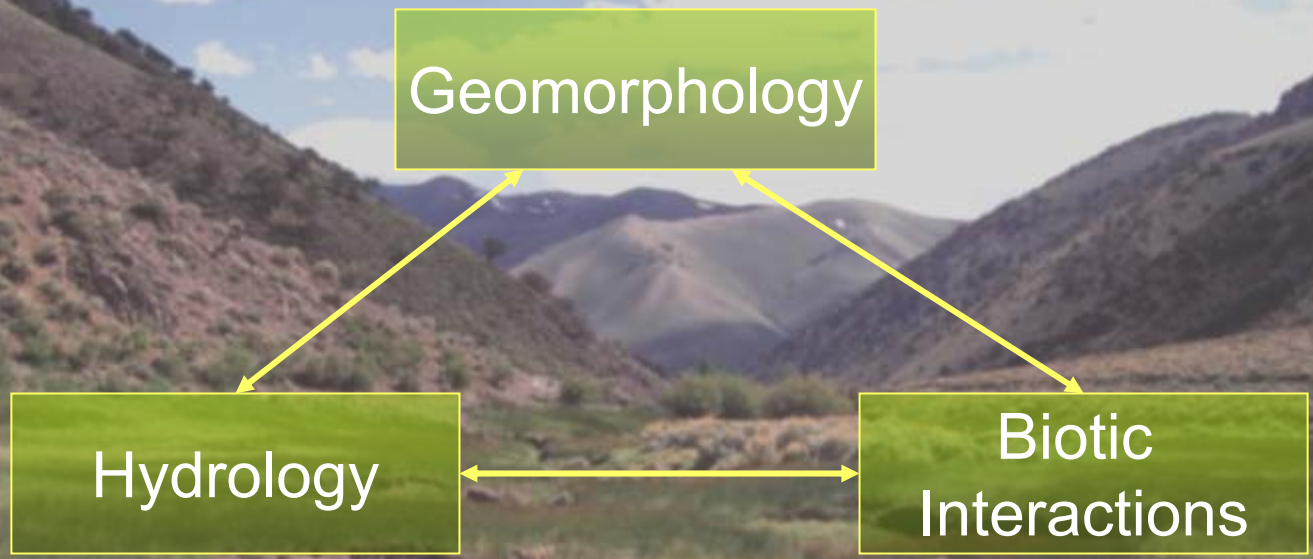
- University of Nevada, Reno
- Western Carolina University
- Lafayette College
- Stanford University
- University New York, Buffalo

Interactive Model



- Yearly Field Tours and Research Reviews
  - Management Needs
  - Research Findings
  - Future Directions
  - Collaborative Projects

Process-based Approach



- Spatial Scales – Watershed, Riparian Corridor, Stream Reach or Riparian Ecosystems
- Temporal Scales – Mid-late Holocene, Post-settlement (past 160 yrs), Present (up to 10 yrs)

Understanding of Stream & Riparian Ecosystem Processes

Vegetation History

- Climate sensitive systems
- Major vegetation changes during Holocene
- Drought 2500 to 2000 YBP

Geomorphic History

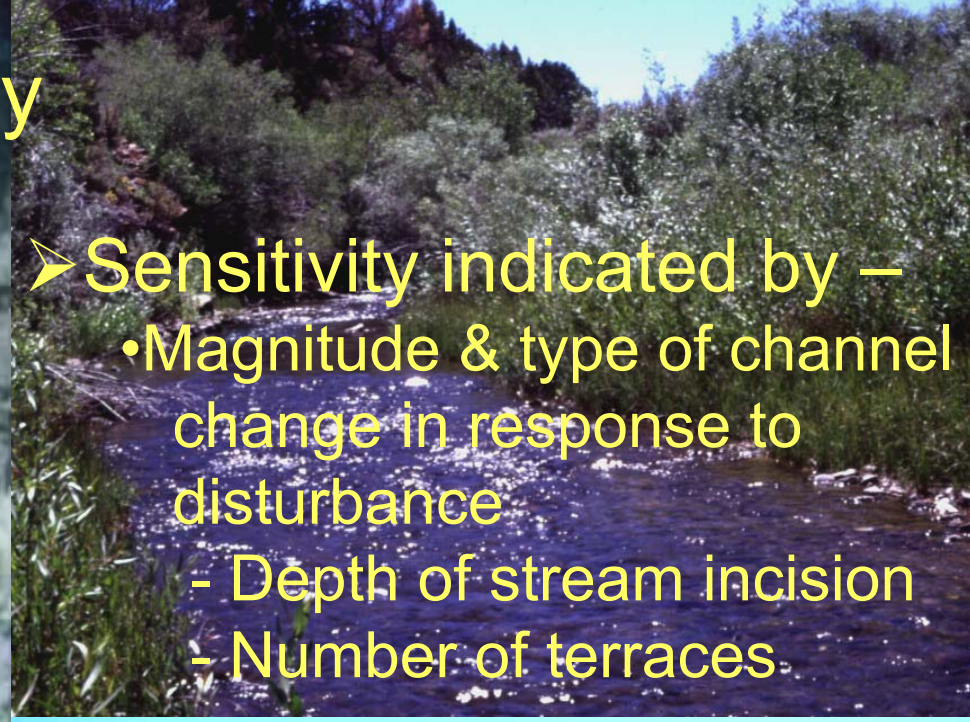
- Drought 2500 to 2000 YBP
  - Hillslopes stripped of sediment
  - Deposited on valley floor & side-valley alluvial fans
- Streams sediment limited - natural tendency to incise

Understanding of Effects of Anthropogenic Disturbance

- Increases rate and magnitude of incision
  - Roads
  - Overgrazing by livestock

Model of Basin Sensitivity

- Watersheds vary in sensitivity to disturbance
- Sensitivity determined by –
  - Geology
  - Morphometry
  - Stream gradient & power



- Sensitivity indicated by –
  - Magnitude & type of channel change in response to disturbance
    - Depth of stream incision
    - Number of terraces

Basin Sensitivity Categories for Central Nevada Watersheds

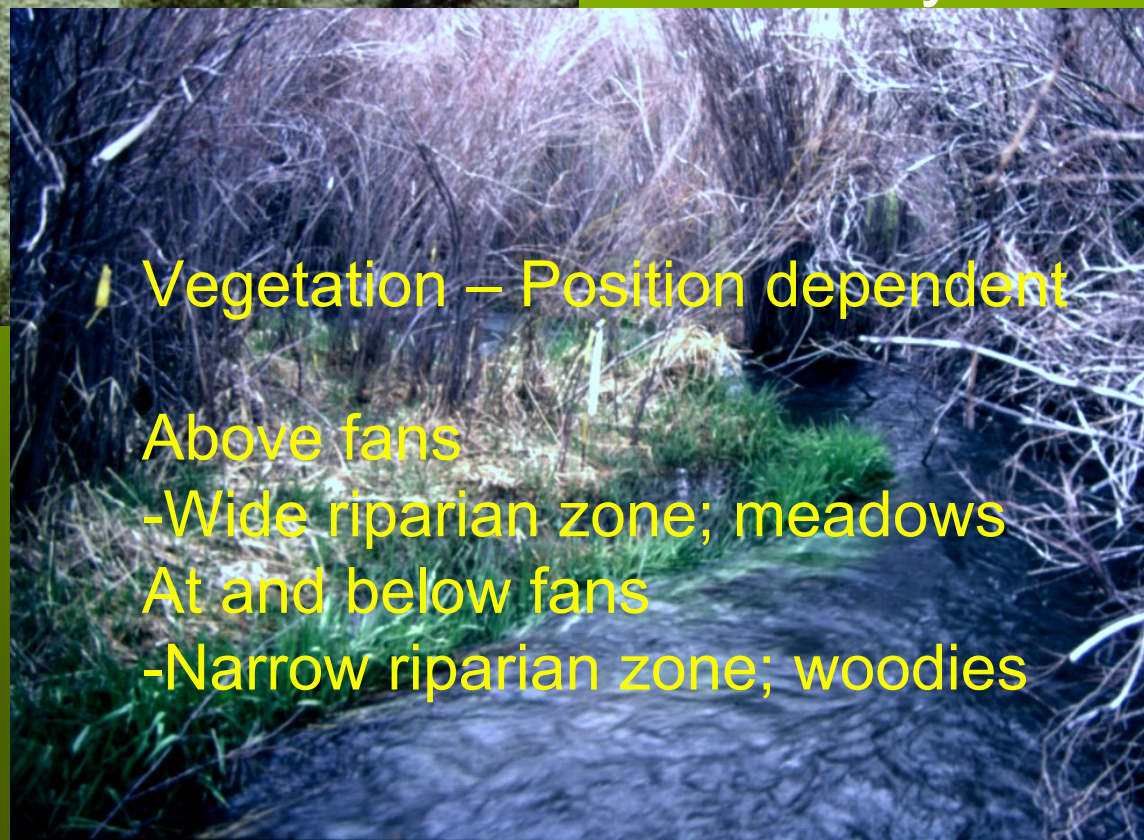
CATEGORY	GEOLOGY	GEOMORPHIC CHARACTERISTICS	VEGETATION TYPES	WATERSHED SENSITIVITY
GROUP 1 Flood Dominated	Tertiary Volcanic rock	•High relief basins •Narrow bedrock controlled •Minimal sediment storage •Multiple, discontinuous terraces	**Terrace dependent -** •*Salix*/forb •Dense rose •*Populus* spp.	Very High
GROUP 2 Deeply Incised channels	Tertiary Volcanic rock	•Large, high relief basins •Incised channels/trenched fans •Multiple, semi-continuous terraces	**Terrace dependent -** •*Salix*/grass or forb •*Rosa* •*Artemisia*	Low to Moderate
GROUP 3 Fan Dominated	Sedimentary and Meta-sedimentary rock	•Lower relief basins •Large side-valley fans •Metastable channels with low incision values, but active downcutting	**Above Fans –** •Wide riparian zones; Meadow complexes **At and Below Fans –** •Narrow riparian zones; Woody riparian types	Low to Moderate
GROUP 4 Pseudo-stable Channels	Intrusive igneous, and Sedimentary rock	•Moderate/minor incision •Potential for catastrophic incision via groundwater sapping •Cobbles or smaller bed material •Multiple, discontinuous terraces where incised	**Unincised reaches -** •Meadow complexes, Artemisia types **Incised reaches –** •Meadow vegetation in trough; Artemisia types on upper terraces	Moderate to High

Kingston Creek

Group III
Fan Dominated
Low/Mod
Sensitivity

Geology/Geomorphology

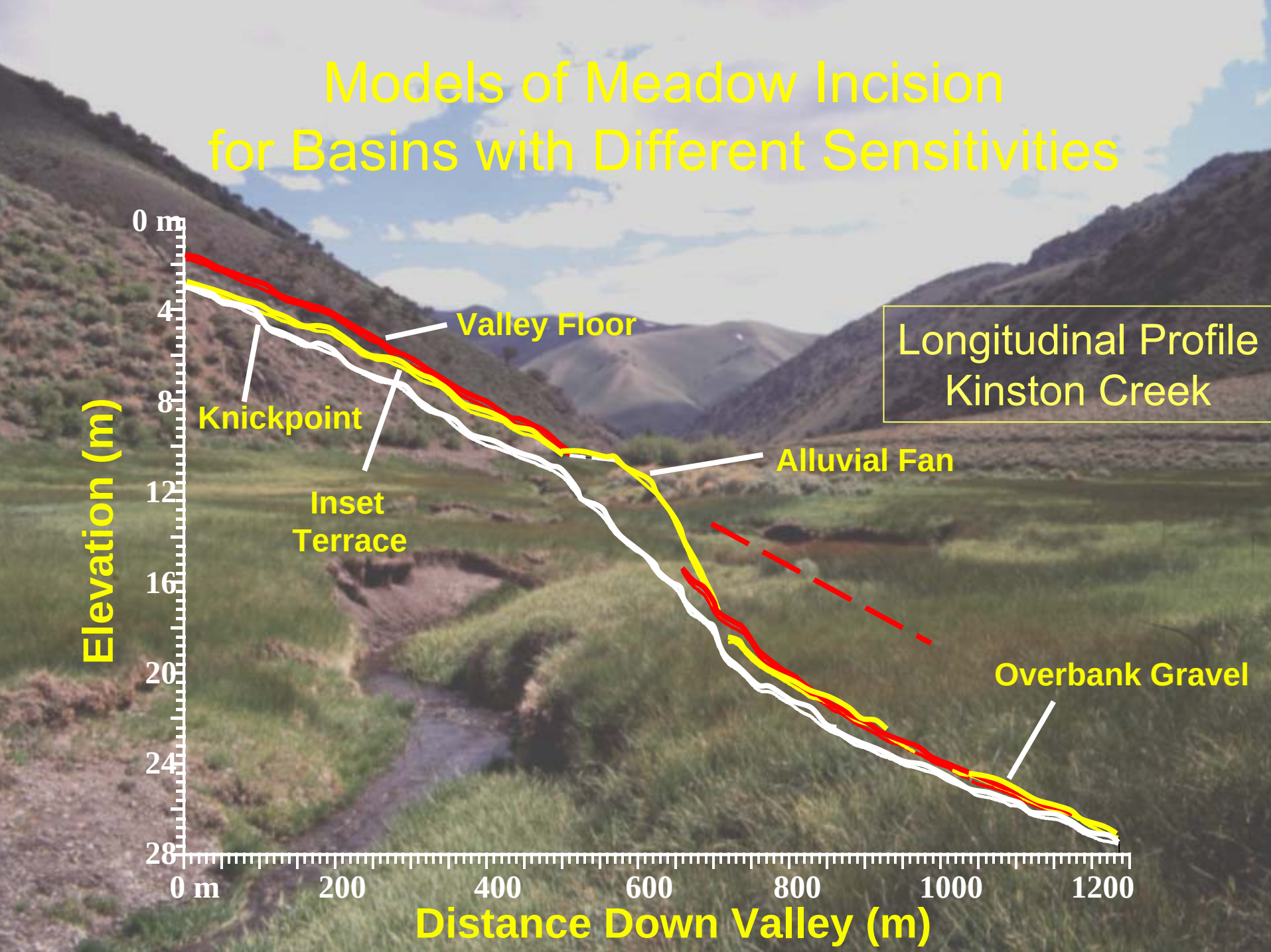
- Sedimentary/meta-sedimentary
- Large side-valley fans
- Moderately incised/ coarse grained channels
- Large variations in erosion & deposition



Vegetation – Position dependent

Above fans
-Wide riparian zone; meadows
At and below fans
-Narrow riparian zone; woodies

Models of Meadow Incision for Basins with Different Sensitivities



Understanding of Relationships among Incision, Hydrology and Meadow Vegetation

Conceptual Basis for Management and Restoration

- Many streams and riparian ecosystems are functioning as nonequilibrium systems
  - Incision will continue due to sediment limitation
  - Rate and magnitude of incision is increased by anthropogenic disturbance
- Watersheds vary in their sensitivity to disturbance
  - Some streams have adjusted to the current geomorphic conditions; others are still adjusting

Conceptual Basis for Management and Restoration

- Return to the predisturbance state is an unrealistic goal for both streams and riparian ecosystems following incision

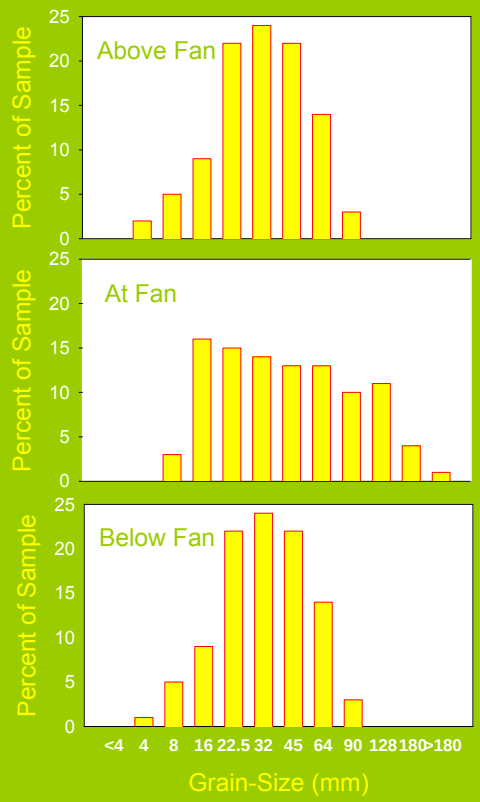
- Managing for sustainability is still a valid goal
  - Recognize streams are in an incisional phase
  - Base concepts of sustainability on current stream processes and riparian ecosystem conditions
  - Use holistic restoration approaches that include all scales

Process-based Restoration Approaches - Meadow Ecosystems

- Use understanding of basin sensitivity and geomorphic processes to develop a system for prioritizing meadow restoration efforts

- Develop methods for increasing stability of valley segments/ stream reaches currently incising or at risk of incision
  - Group 3 streams characterized by fans with knickpoints are among best candidates for stabilization
  - Alluvial fans often act as base level controls determining local rates of incision

Strategically place loose rock structures in channel where it crosses the fan may stabilize the stream and prevent meadow incision



Results - Products

- Over 50 Publications
  - Peer-reviewed articles, book chapters, proceedings papers, theses
- Over 60 presentations at conferences, workshops and meetings
- Four symposia -
  - Understanding the Linkages Between Geomorphic and Ecological Processes
  - Understanding & restoring Great Basin Riparian Ecosystems & Meadows
    - ESA 1999
    - GSA 2000
    - ESA/SER 2002
    - GSA 2005

Results - Products

- Results to date have been synthesized
- 2004 Island Press book – SER Restoration Series

"…the process-based approach is applicable elsewhere & should be carefully considered by restoration ecologists"

Jeffrey Braatne

Ecology

www.unr.cabnr.edu/gbem